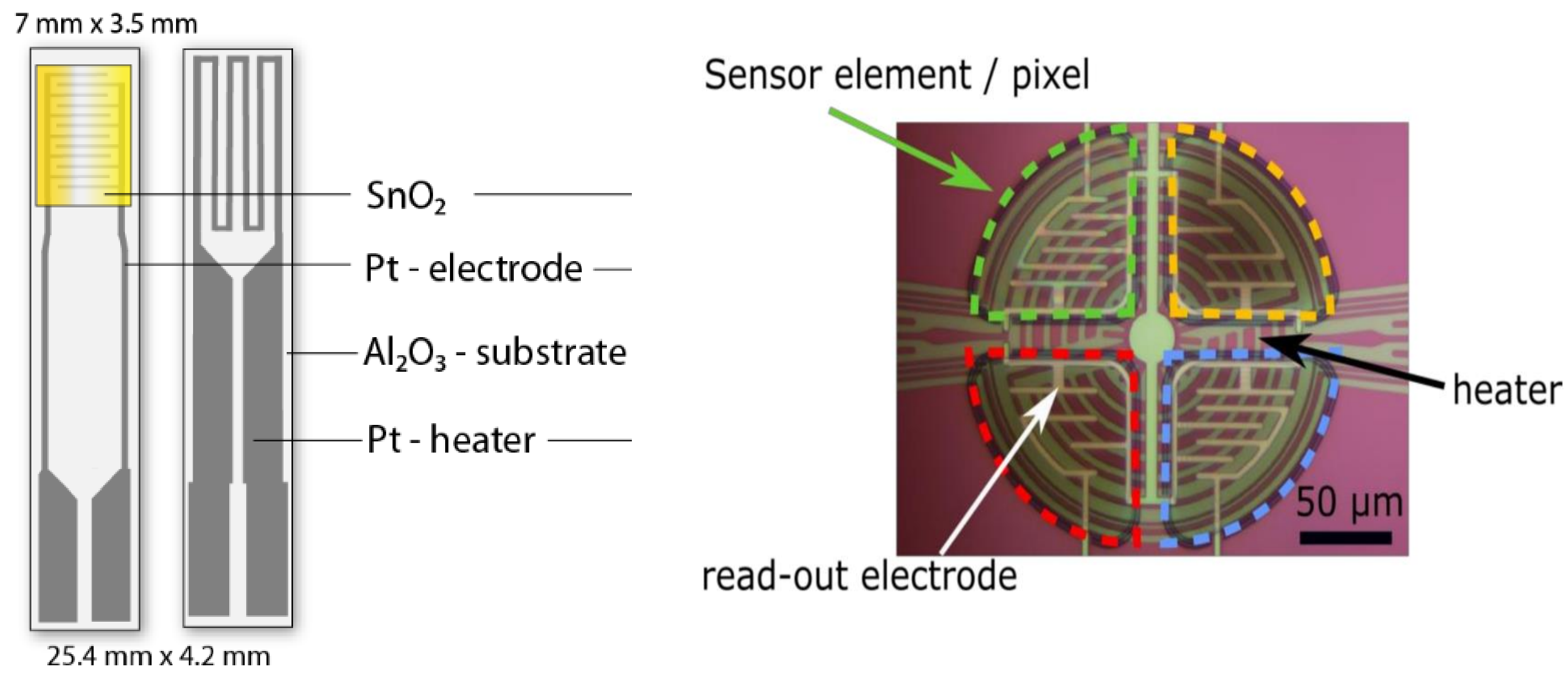


# Semiconducting Metal Oxide-Based Gas Sensor

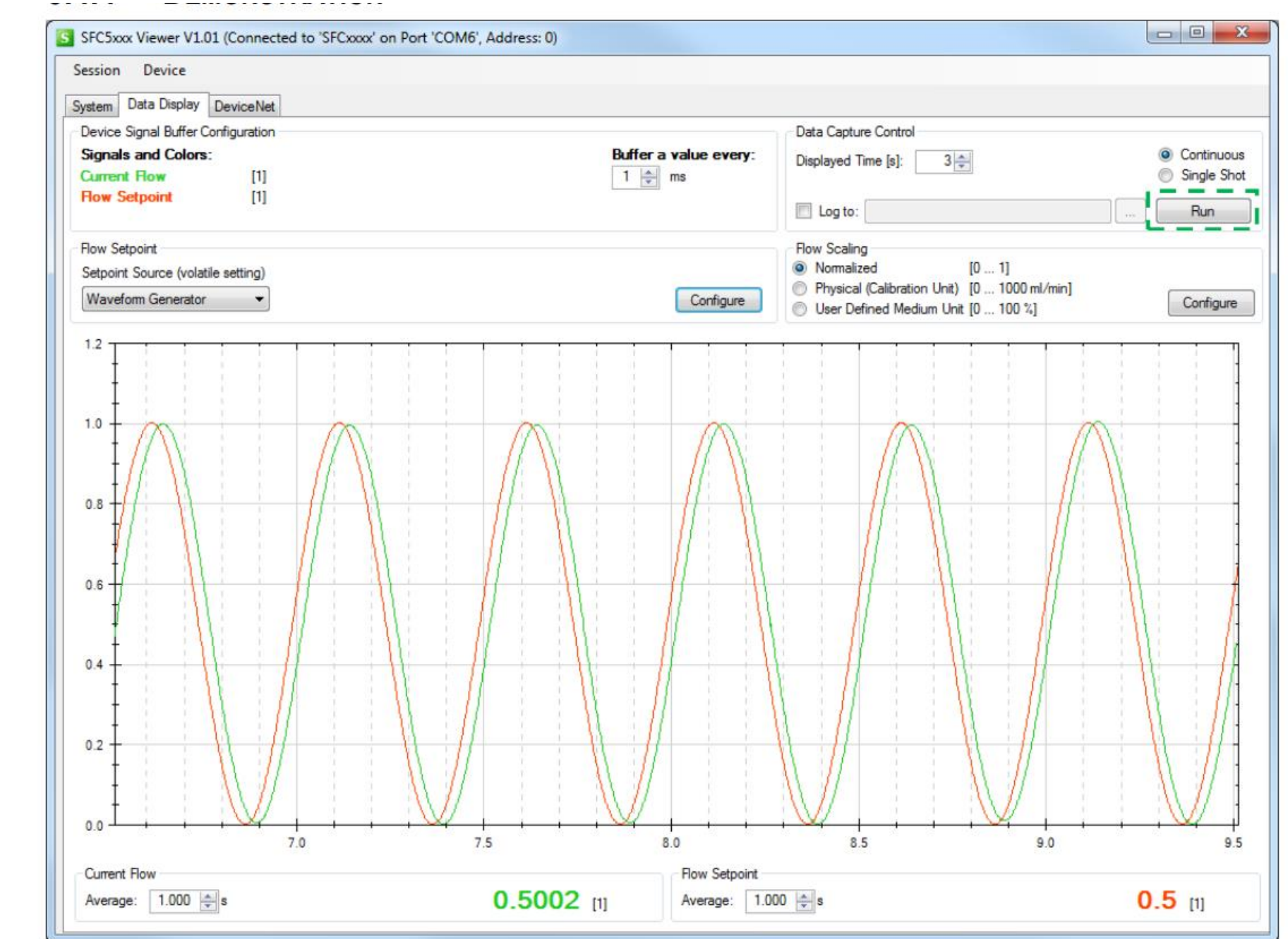
**Kazi Rifat Bin Rafiq, Anna Staerz**  
**Mechanical Engineering**

## Sensors-Dynamic Implementation

Modern metal oxide gas sensors are very small they are typically operated in dynamic temperature mode (multiple steps per second)  
→ new methods are needed to study this sensors in operando

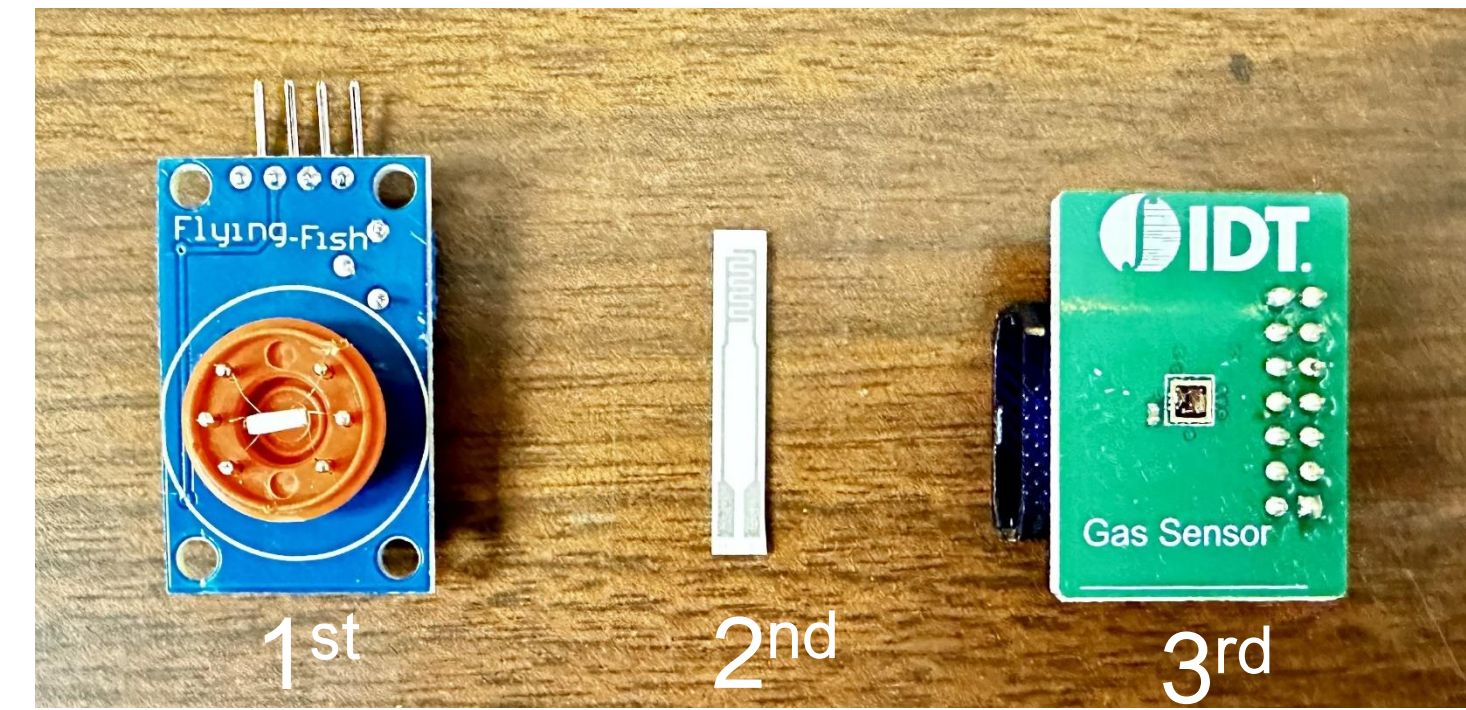


Allows 100 ms gas flow waves



## State of the Art Labscale ≠ Real Sensors (Sensirion)<sup>1</sup> Fastest Scanrate: 10spectra/sec

First sensor is uneven to test in FTIR  
Second sensor is large to apply dynamic implementation  
Third sensor is applicable for dynamic implementation of 13 steps in each second up to 300° C  
→ Third sensor for testing is 50 μ in size



## In-Operando DRIFTS Spectroscopy of Semiconducting Metal Oxides

- Semiconducting metal oxide gas sensors
- Ubiquitous use; health, safety, pollution
- Effect of temperature and humidity
- Temperature up to 300° C and RH of 20%
- Material design and mechanism elucidation

**Transmission**  
IR beam transmitted through dilute sample

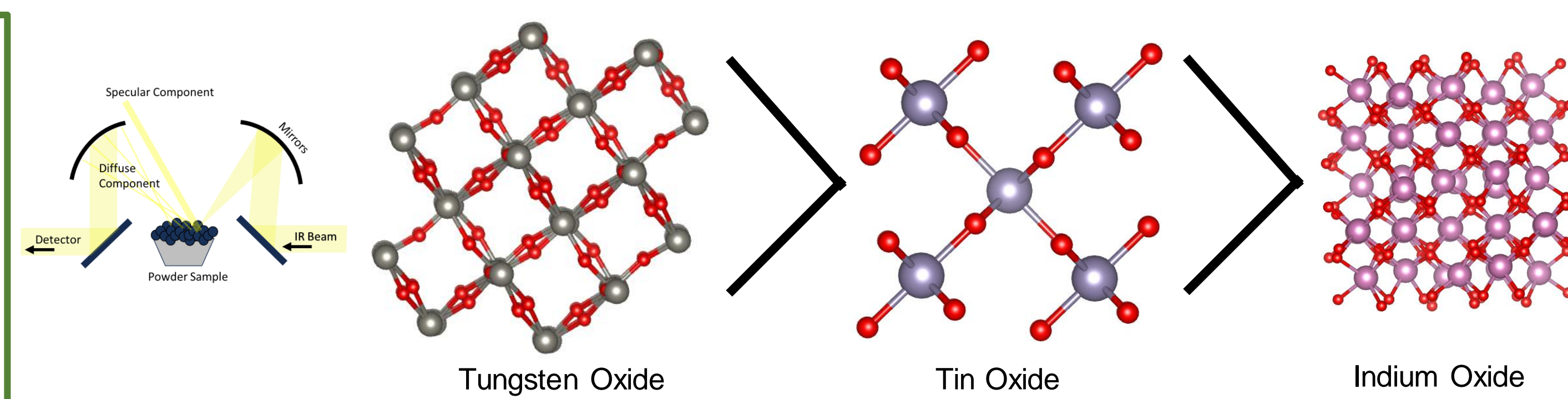
-Sample must be sufficiently transparent and self-sustaining

**Emission**  
IR radiated from a heated sample

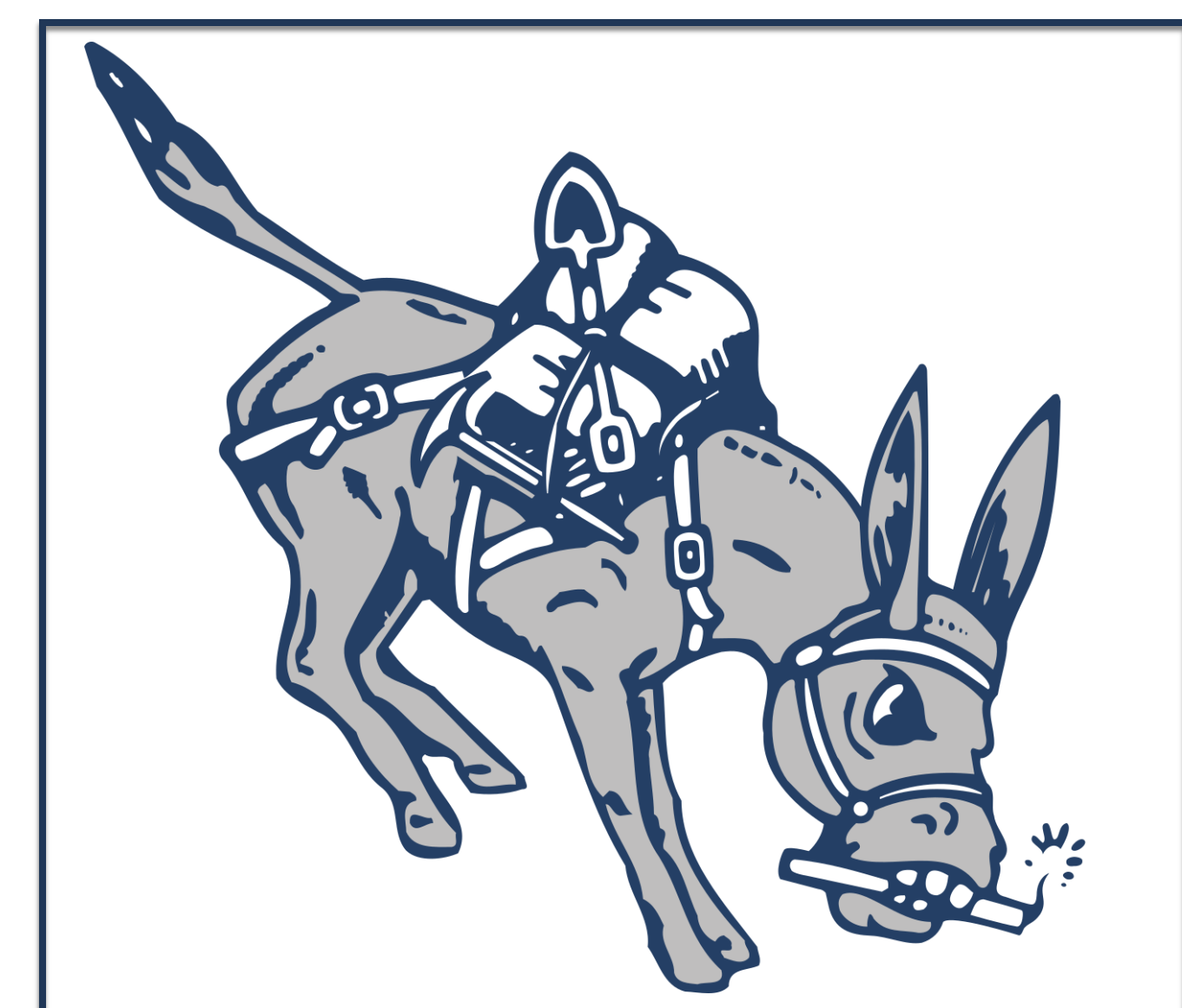
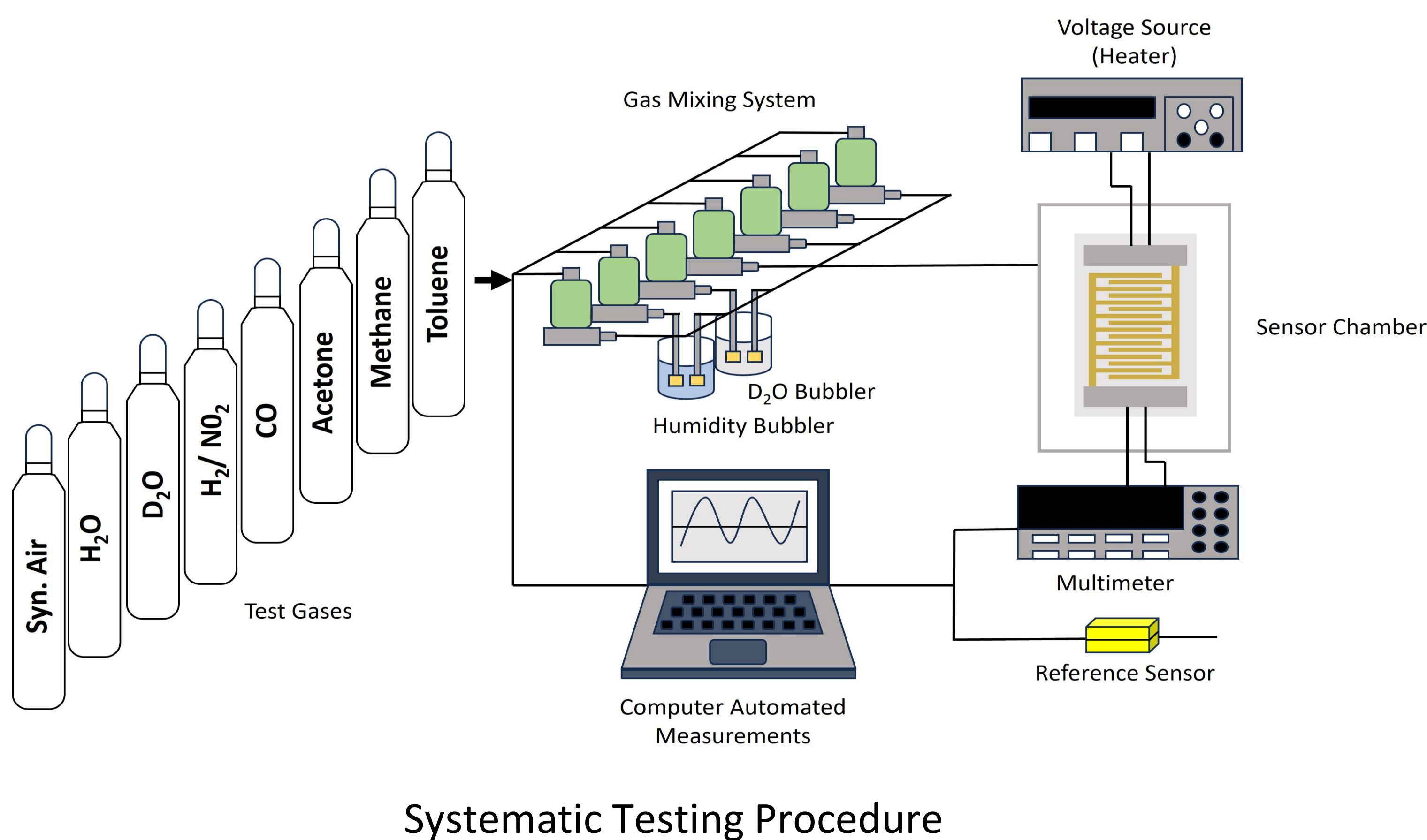
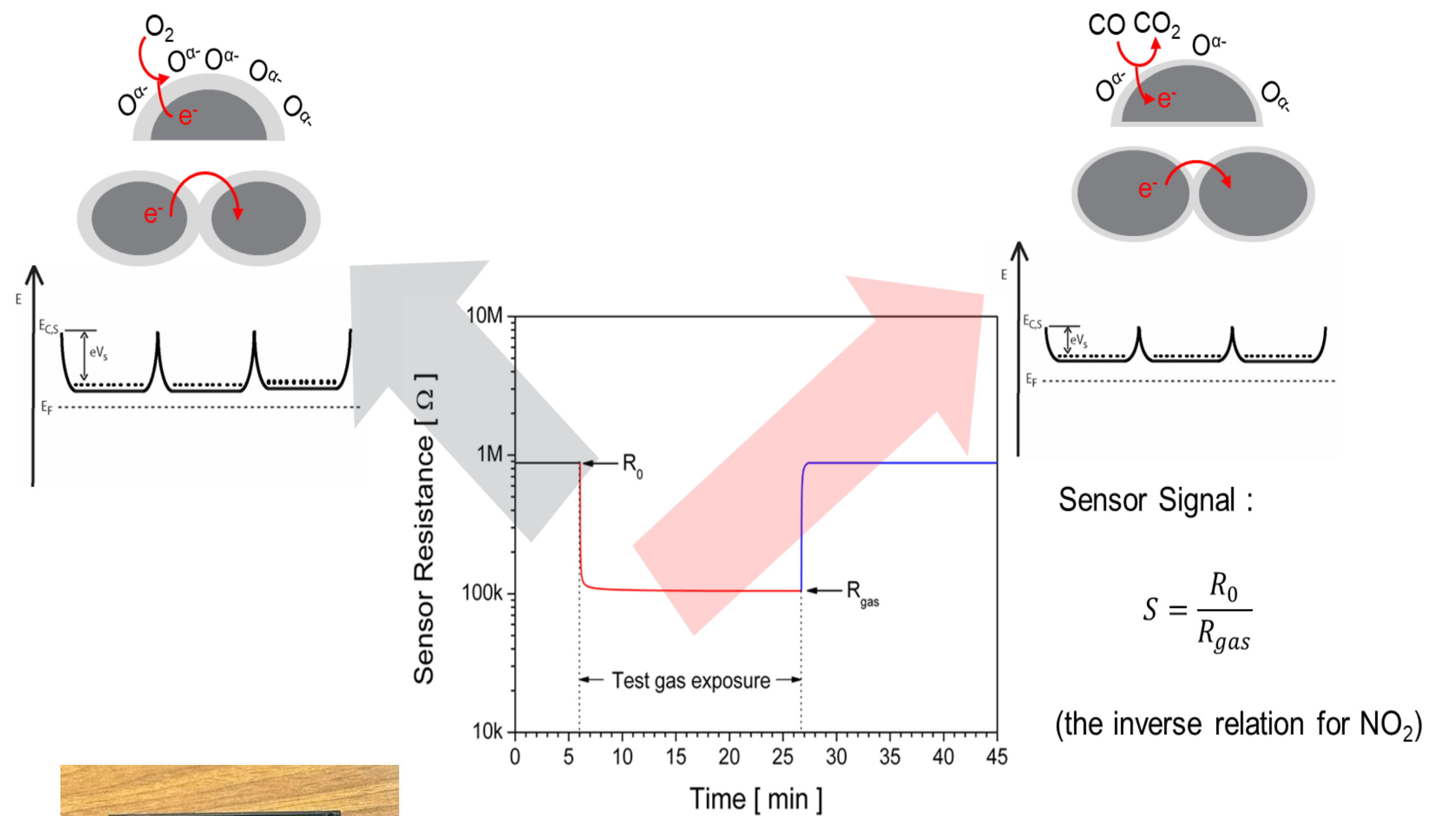
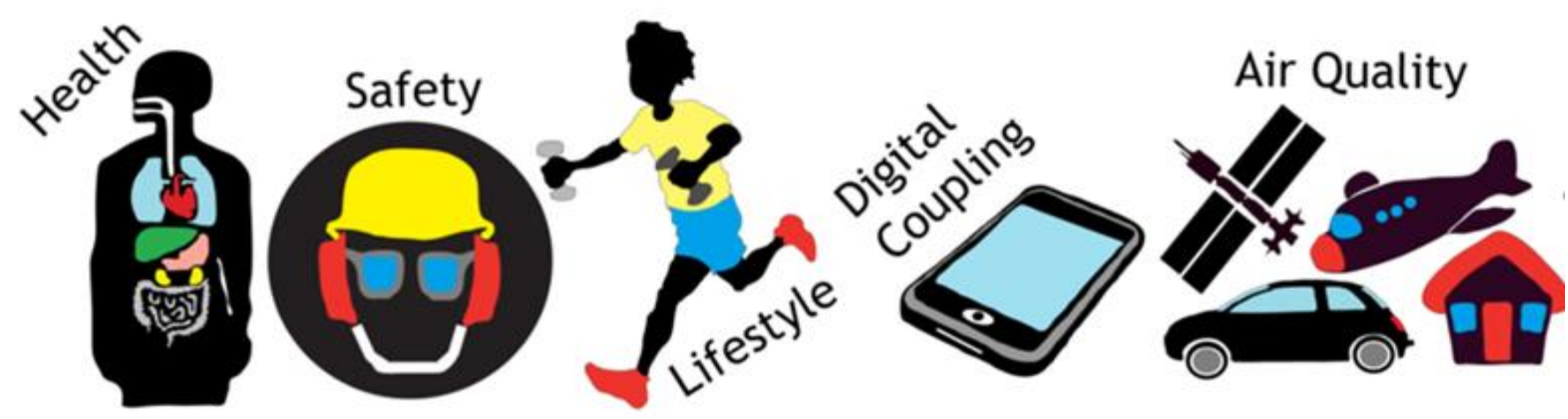
-Easily applied  
-Surface vibrational excitations weak and strong blackbody radiation background

**Diffuse Reflectance**  
Focused IR beam irradiates powder sample and the scattered light collected using a parabolic mirror

-Highly surface sensitive  
-Diffuse signals tend to be weak  
-complicated optical configuration



<sup>[1]</sup> Zaera F. New advances in the use of infrared absorption spectroscopy for the characterization of heterogeneous catalytic reactions. Chem Soc Rev. 2014;43(22):7624-7663.  
<sup>[2]</sup> Fagpy P, Lu X, Abenathy H, Lu M. In situ potential-dependent IR emission spectroscopy: A novel probe for high temperature fuel cell interfaces. Proc - Electrochem Soc. 2005;PV 2003-30:230-244.



The expectation is Tungsten oxide would provide better result and less degradation than Tin oxide and Indium oxide. Tin and Indium (oxide) hydroxylate while Tungsten oxides doesn't make hydroxylation.